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SOURCE MULTIPLICITY EXAMINED WITH MINIMUM ENTROPY DECONVOLUTION

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13. ABSTRACT *(Maximum 200 words)*

This report contains the preliminary results of a study to determine the usefulness of minimum entropy deconvolution in detecting seismic source multiplicity and its potential for discriminating ripple-fired explosions from other seismic events. Specific examples of its application to quarry blast data and synthetic seismograms are discussed.

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1. OBJECTIVES

The objective of this project in the first year is to develop a technique, based on minimum entropy deconvolution (MED), useful for discriminating ripple-fired explosions from other seismic events.

2. PROGRESS

During the last quarter we experimented further with data from a known quarry blast and synthetics. Figure 1 shows a bore hole vertical component record from LNO, for a known quarry blast at a distance of approximately 40 km. After some experimentation with the filter length, damping coefficient and data window position and length, some new results have been obtained for this data. The record from LNO is shown as the top trace in Figure 1. The sampling rate was 60 sps. The middle trace shows the first 4 seconds of the signal that was input to the MED algorithm. One 4-second MED filter was generated which deconvolved this signal into the trace shown at the bottom of Figure 1. It is tempting to interpret the deconvolved trace as 4 phase arrivals, the first three consisting of two closely spaced spikes due to source effects. The time separation between the spikes in each doublet is 50 msec. The quarry shot layout consisted of two rows of shots, 27 shots total. The delay time between individual shots was approximately 9 msec. The delay time from the start of the first row to the start of the second row was 42 ms. Could the double nature of the deconvolution be due to this delay time?

Because of the nonlinear behavior of the algorithm, it is very difficult to have confidence in such an interpretation of the deconvolution. Different deconvolutions can be obtained for the same data window by simply varying the filter length or damping coefficient. Figure 2 shows 4 deconvolutions for the data window of Figure 1. Each trace in Figure 2 was generated by simply varying the filter length or the damping coefficient.

We have tested the algorithm on synthetic data (60 sps) generated by summing time shifted copies of real data, with time delays equal to the quarry blast delays with a 10 percent random perturbation. Synthetics were also made with simulated time delays equal to a multiple of the actual time delays. Using the MED algorithm we were only able to deconvolve some of the simulated shot times when the delay times were increased by a factor of 5, from approximately 10 to 50 msec. In this case, shown in Figure 3, the simulated shot delay time was approximately equal to 3 sample intervals.

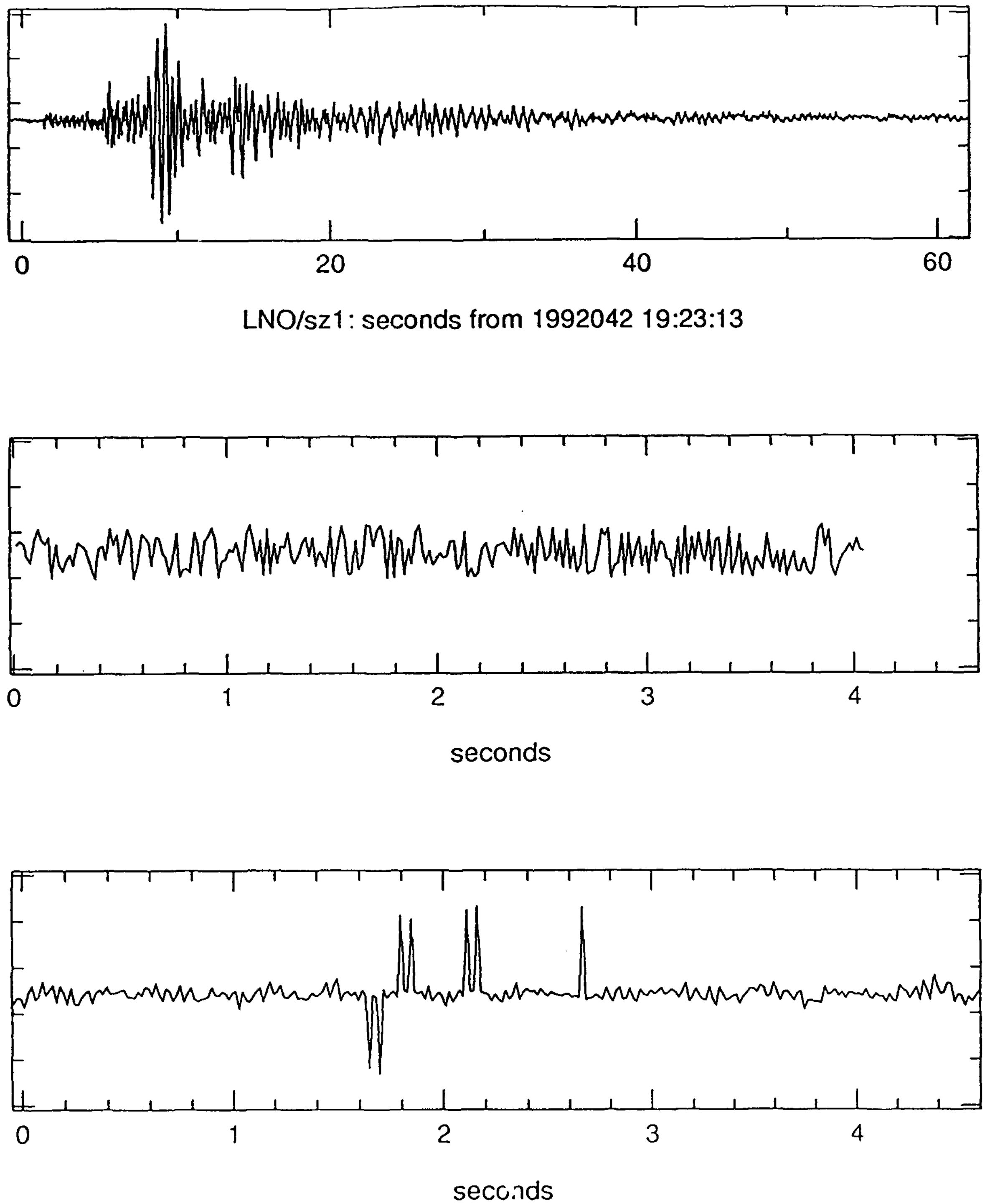

Figure 1. top: LNO/sz recording for a quarry-blast at a distance of 40 km. middle: the first 4 seconds of the signal used as input to the MED algorithm. bottom: one of the deconvolution results obtained for this data window.

3. FUTURE PLANS

The work to date suggests that a sample rate, higher than what is readily available, will be required in order to recover the original ripple-fired quarry blast sequence with this method. As an aid in investigating the relationship between ripple-fire shot spacing, sample rate, receiver distance and recovery efectiveness, simple synthetic seismograms with reasonable shot spacing and receiver geometry will be generated. Once the limitations of this method are more fully explored suitable data will be sought and examined.

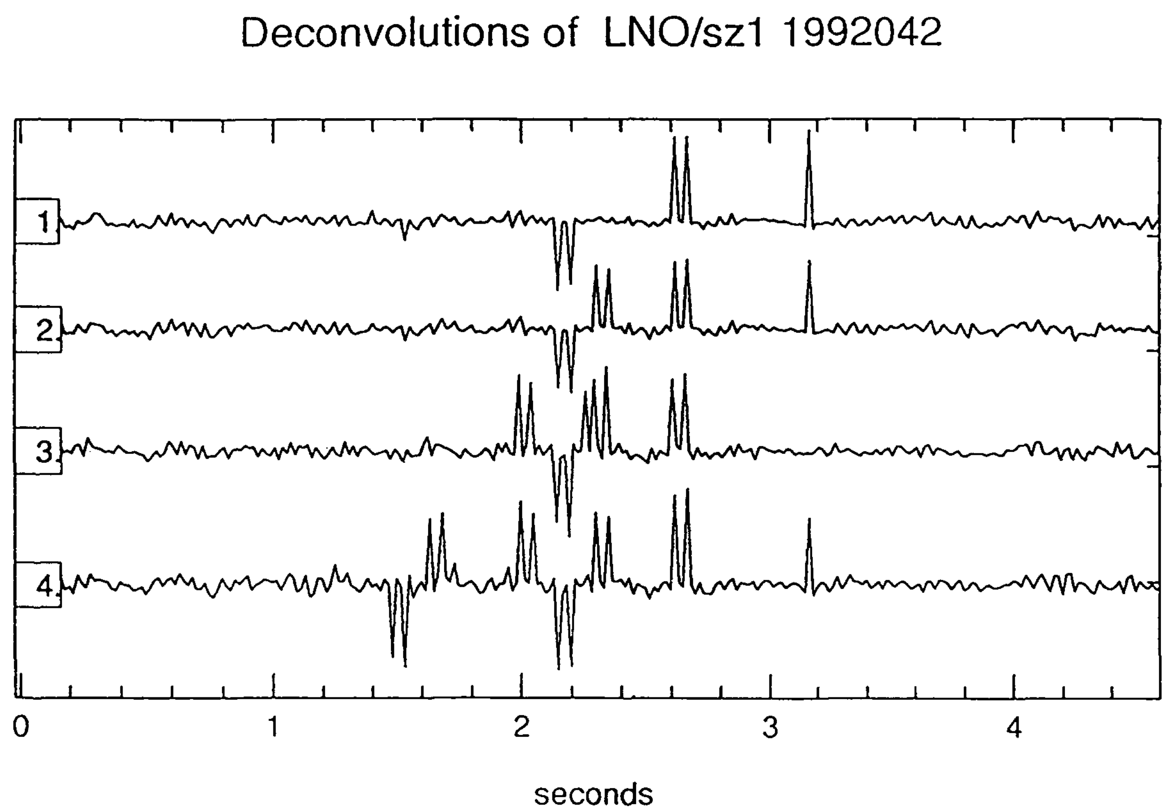

Figure 2. Four deconvolutions obtained for the data window shown in the Figure 1. Each trace resulted from different values for the filter length and/or damping coefficient.

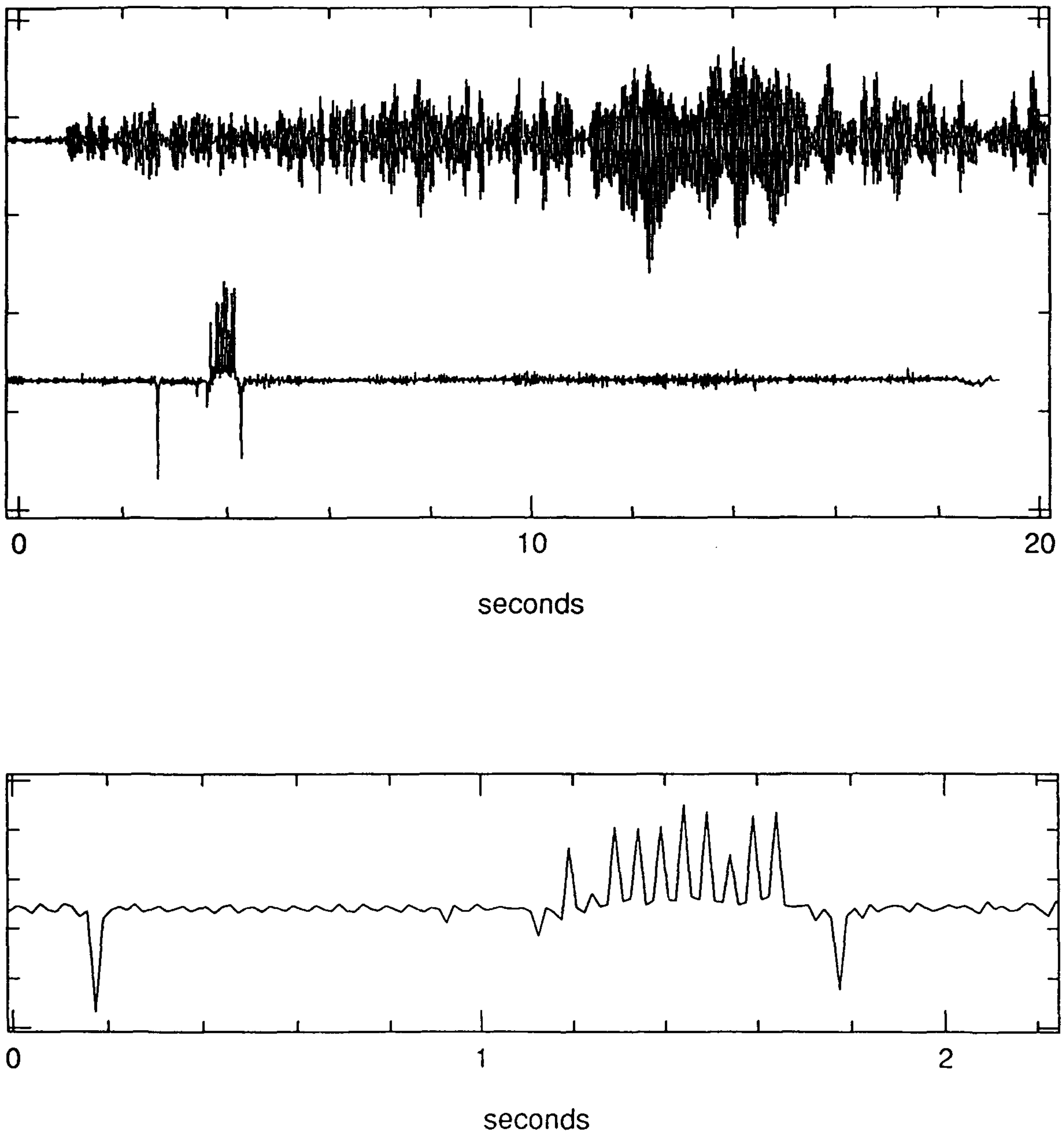

Figure 3. Top: Synthetic generated by summing data 27 copies of a 60 sps LNO record with a 50 msec time delay. The synthetic has been bandpassed to 15-30 Hz. Middle: A deconvolution of the synthetic using a 9 second filter. Bottom: The deconvolution shown at an enlarged scale. Approximately 9 of the 27 shots have been deconvolved.

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